

# Exhibit X

# Chrysotile PLM Dispersion Staining Colors (ISO)

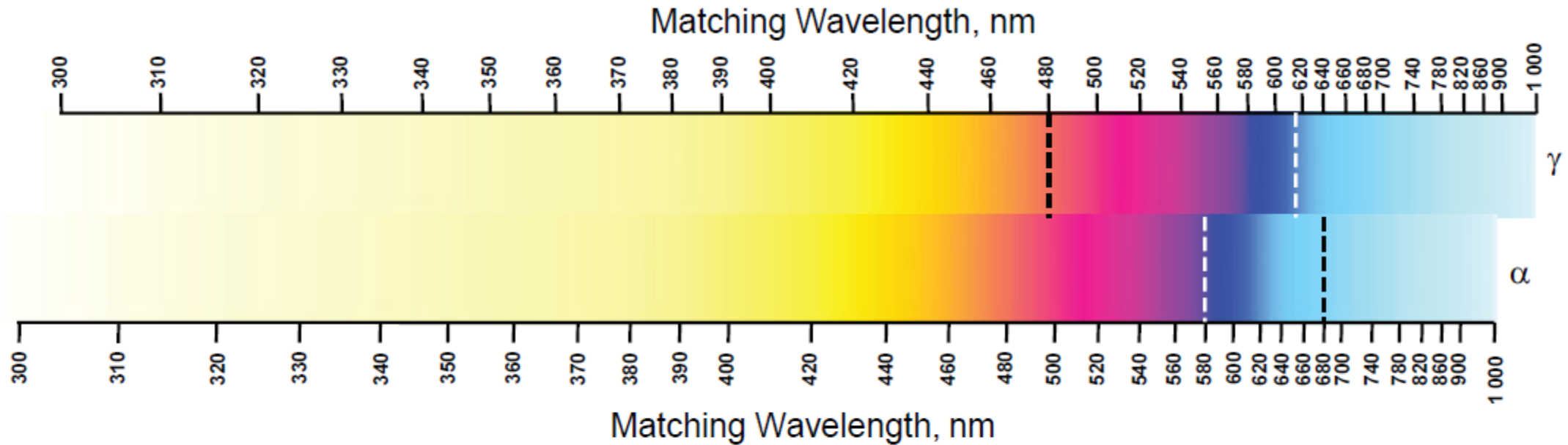


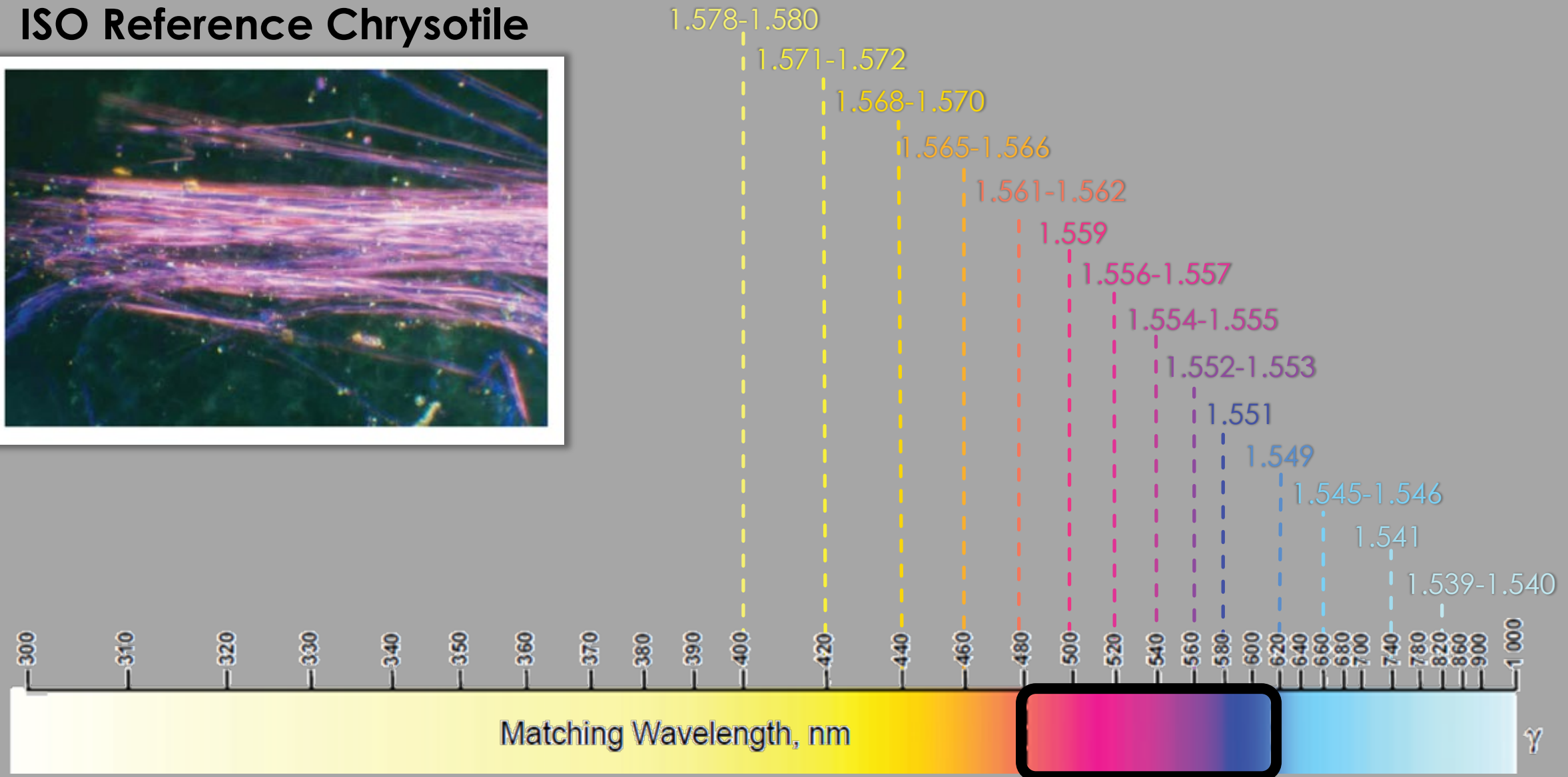
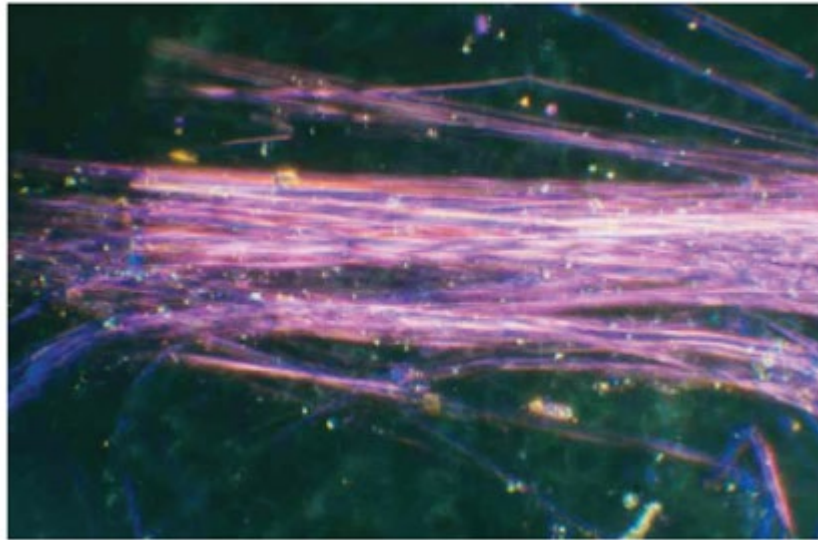
Figure C.1 — Central stop dispersion staining colours for chrysotile in 1,550 RI liquid

**EXHIBIT 4**

WIT: William Longo  
DATE: 3/3/2023  
iDepo

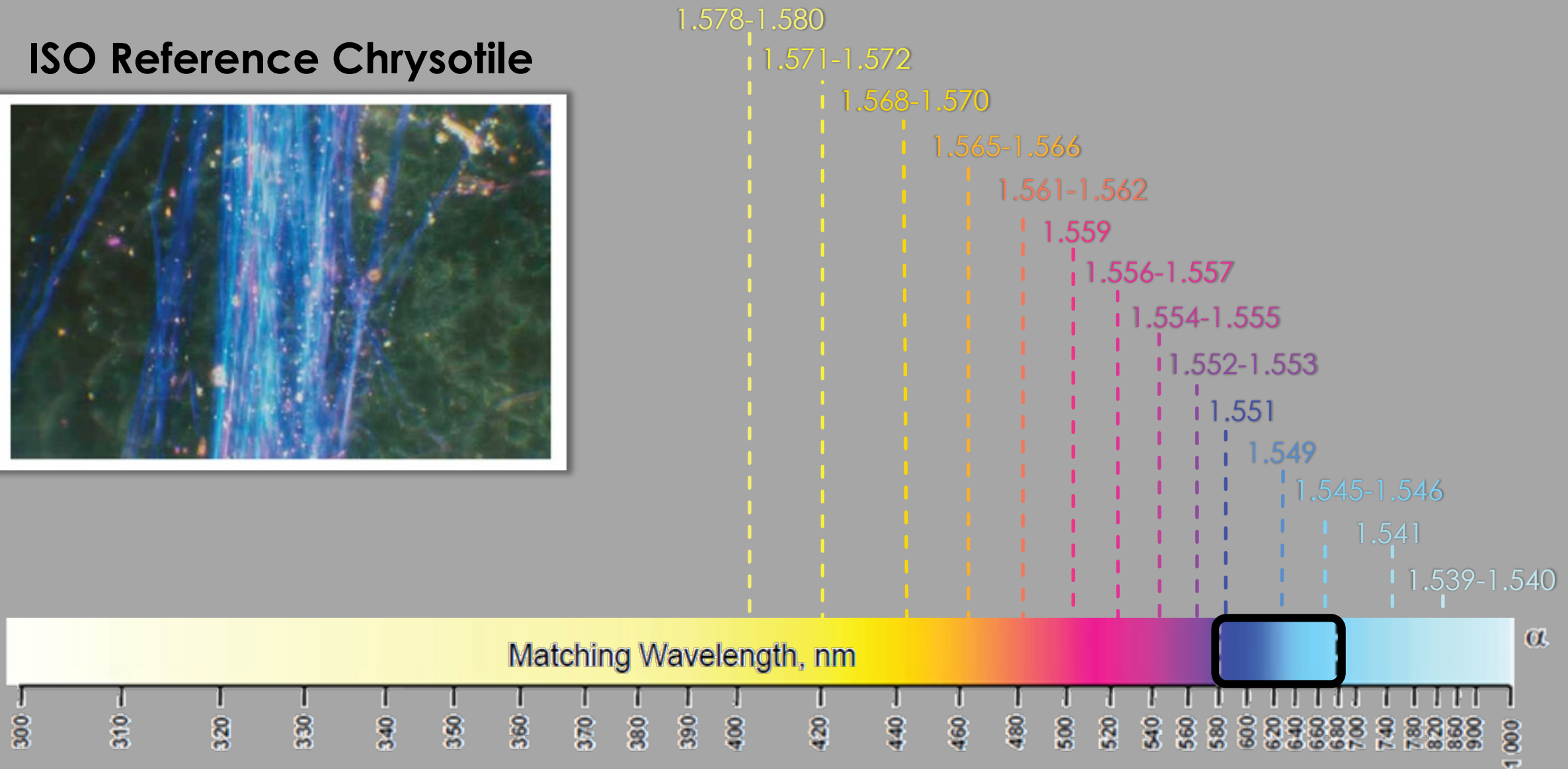
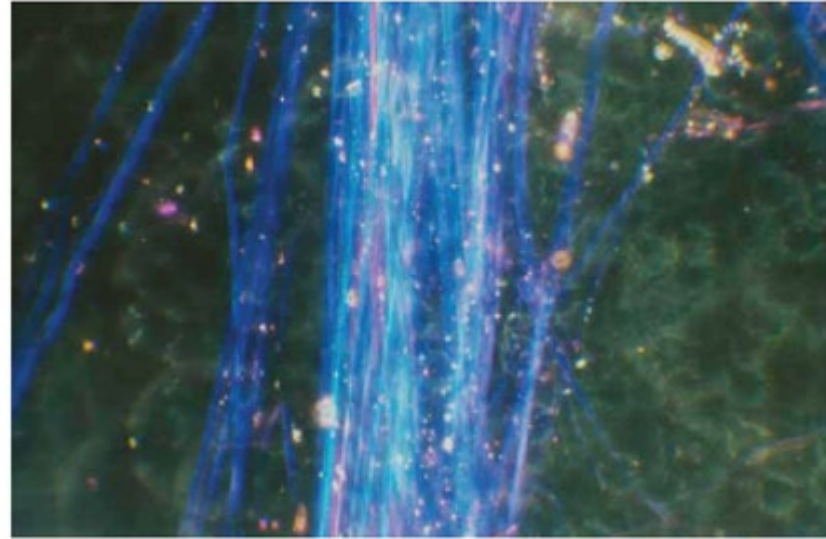
# ISO Reference Chrysotile: Parallel

## ISO Reference Chrysotile

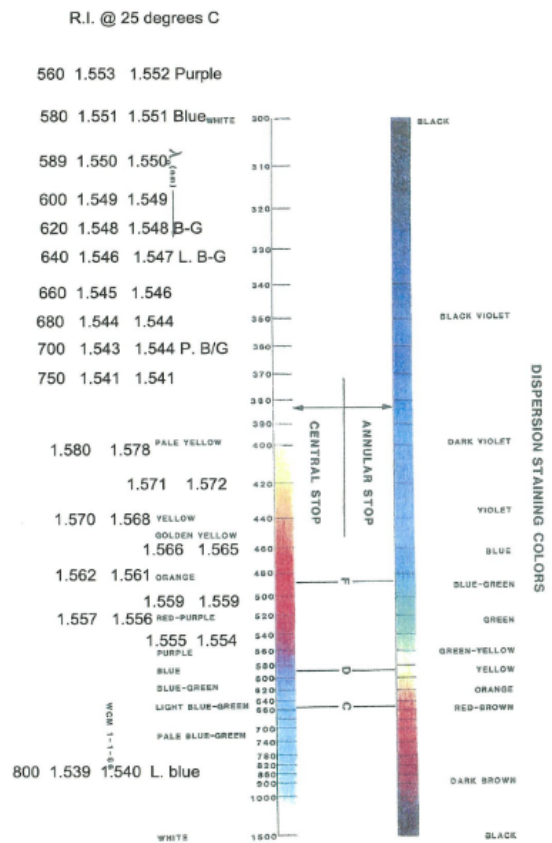


# ISO Reference Chrysotile: Perpendicular

## ISO Reference Chrysotile



# Dr. Longo's PLM Dispersion Staining Chart



# Dr. Su's PLM Dispersion Staining Chart

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DETERMINING ASBESTOS REFRACTIVE INDICES BY DISPERSION STAINING

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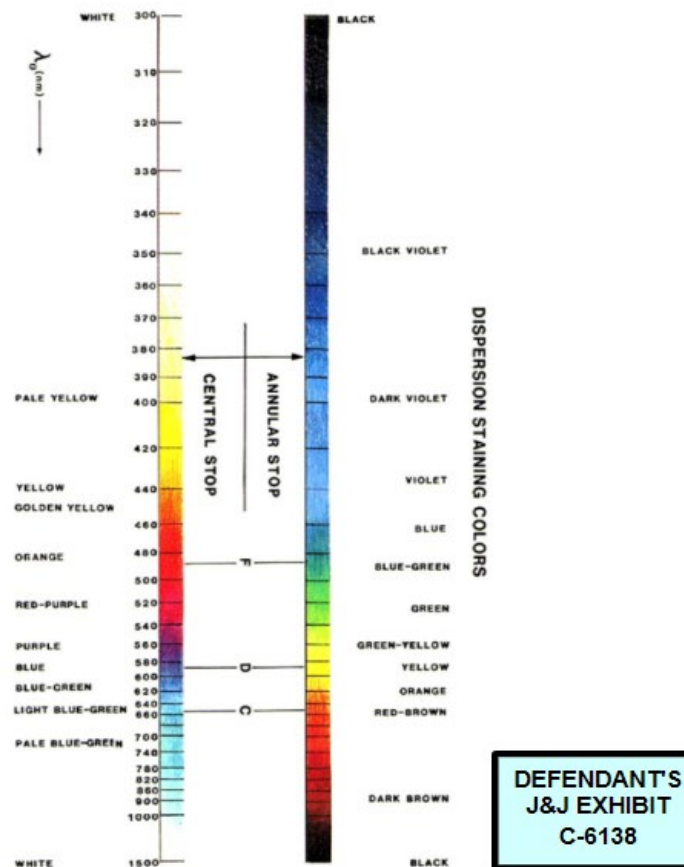
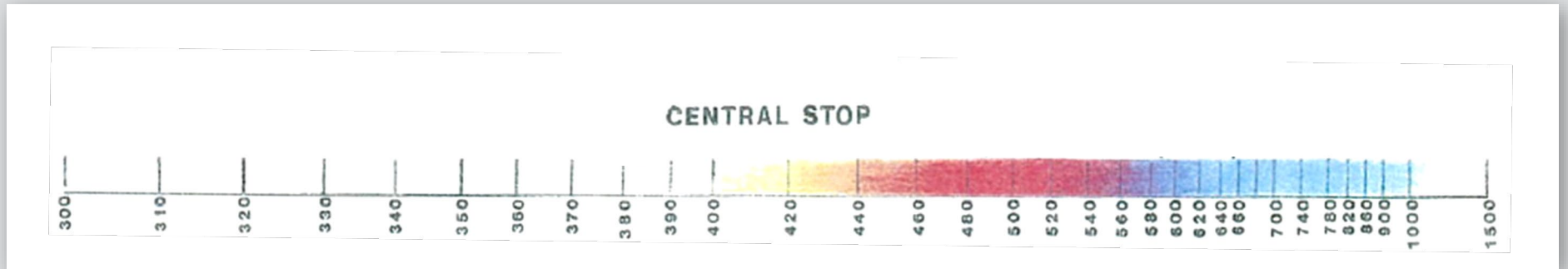


Fig 1. Converting dispersion staining color to corresponding  $\lambda_0$  (McCrone, 1987).

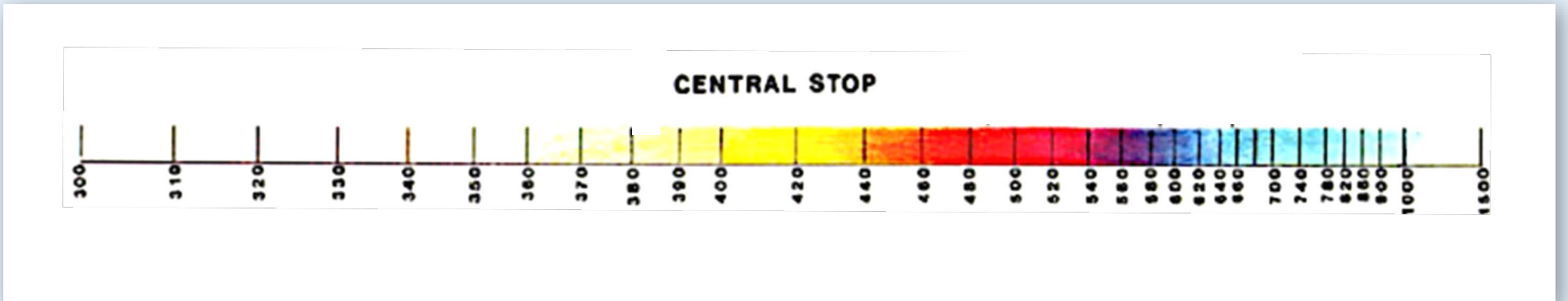
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# PLM DISPERSION STAINING CHART

Dr. Longo's Version



Original Version



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# Birefringence of Talc vs. Chrysotile

**Chrysotile**: **Lower** Birefringence (Colors **Closer Together**)



**Talc**: **Higher** Birefringence (Colors **Farther Apart**)





## SHADE OF YELLOW IMPACTS ONE SIDE OF BIREFRINGENCE

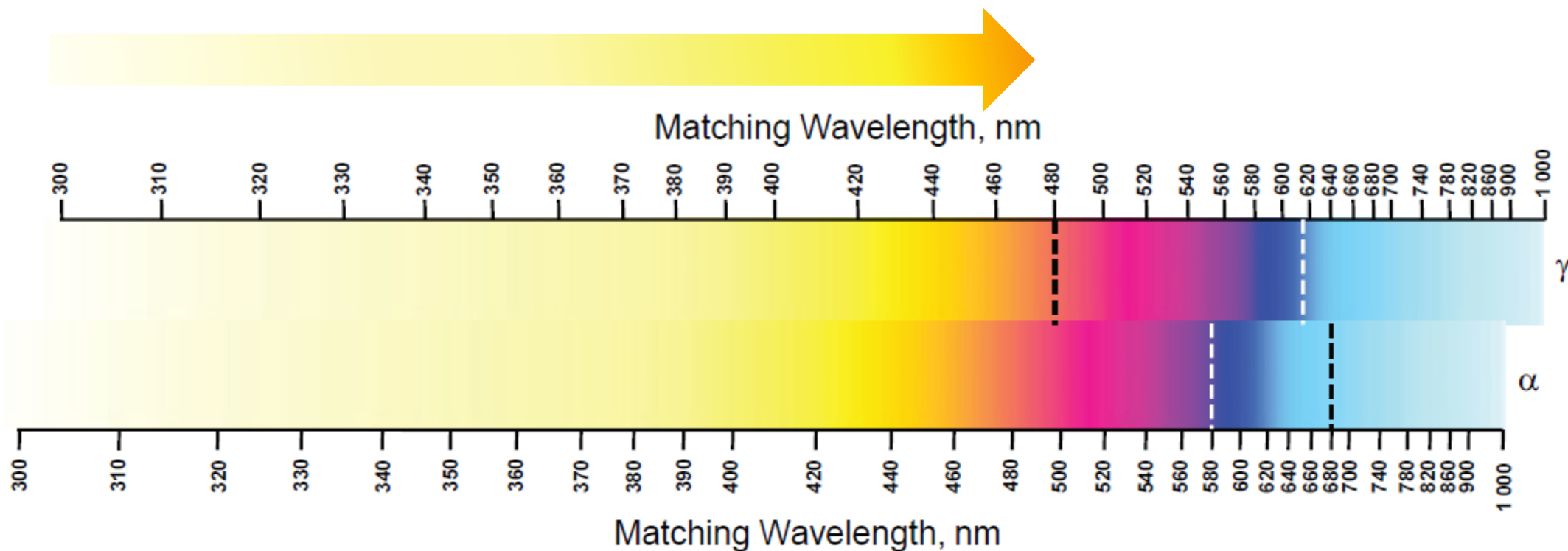


Figure C.1 — Central stop dispersion staining colours for chrysotile in 1,550 RI liquid

# Dr. Su's Method: Avoid Yellow "At All Cost"

DETERMINATION OF REFRACTIVE INDICES OF  
ASBESTOS MINERALS BY DISPERSION STAINING:  
*WHY AND HOW*

is in the *ultraviolet* (instead of the visible) range. Experience tells us that "yellow" is the hardest CSDS color to be quantified and should be avoid at all cost. The same yellow CSDS color could be called "golden yellow", "yellow", "light yellow", "pale yellow", etc., by different analysts and, in the meantime, is more susceptible to the color temperature of light source and the type of daylight filter used than other CSDS colors.

Rev. 2020-06-30

# Yellow Interpretation Problem Not Limited To Amphiboles

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20 BY MR. HYNES:

21 Q. Okay. And that issue about the interpretation  
22 of the color yellow, that's not limited to just  
23 amphibole structures, that's something that Dr. Su, in  
24 this document, is noting is a problem inherent to the  
25 interpretation of structures that show the color yellow

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1 in central-stop dispersion standing oils, right?

2 MR. KRAMER: Objection to form.

3 THE WITNESS: Yes. He doesn't ever put that  
4 in any of the handouts that he gave out in the past, it  
5 was always amphiboles. But now, surprisingly -- not  
6 surprisingly, he's now stepping in this.!

# Dr. Su's PLM Dispersion Staining Chart

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DETERMINING ASBESTOS REFRACTIVE INDICES BY DISPERSION STAINING

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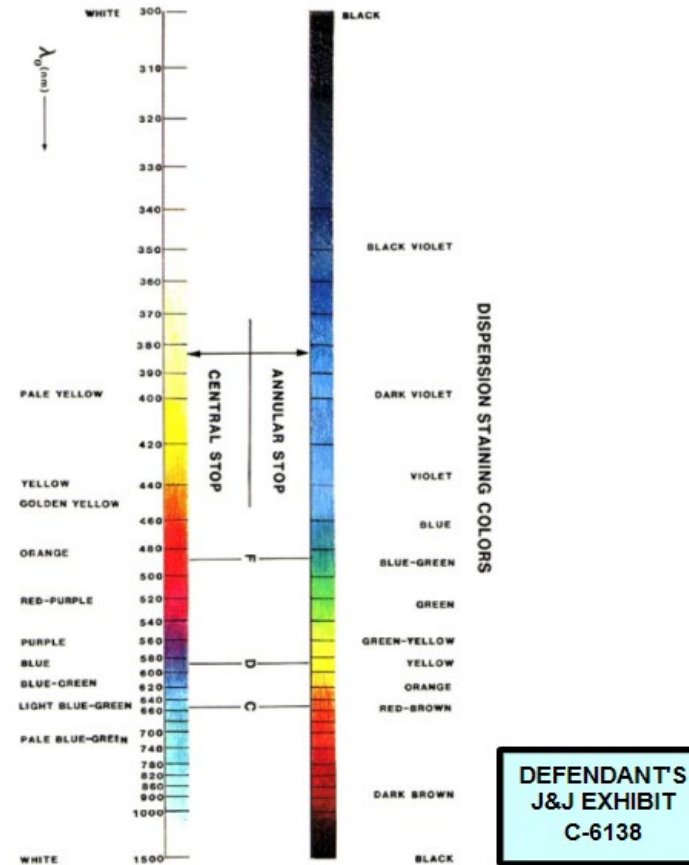
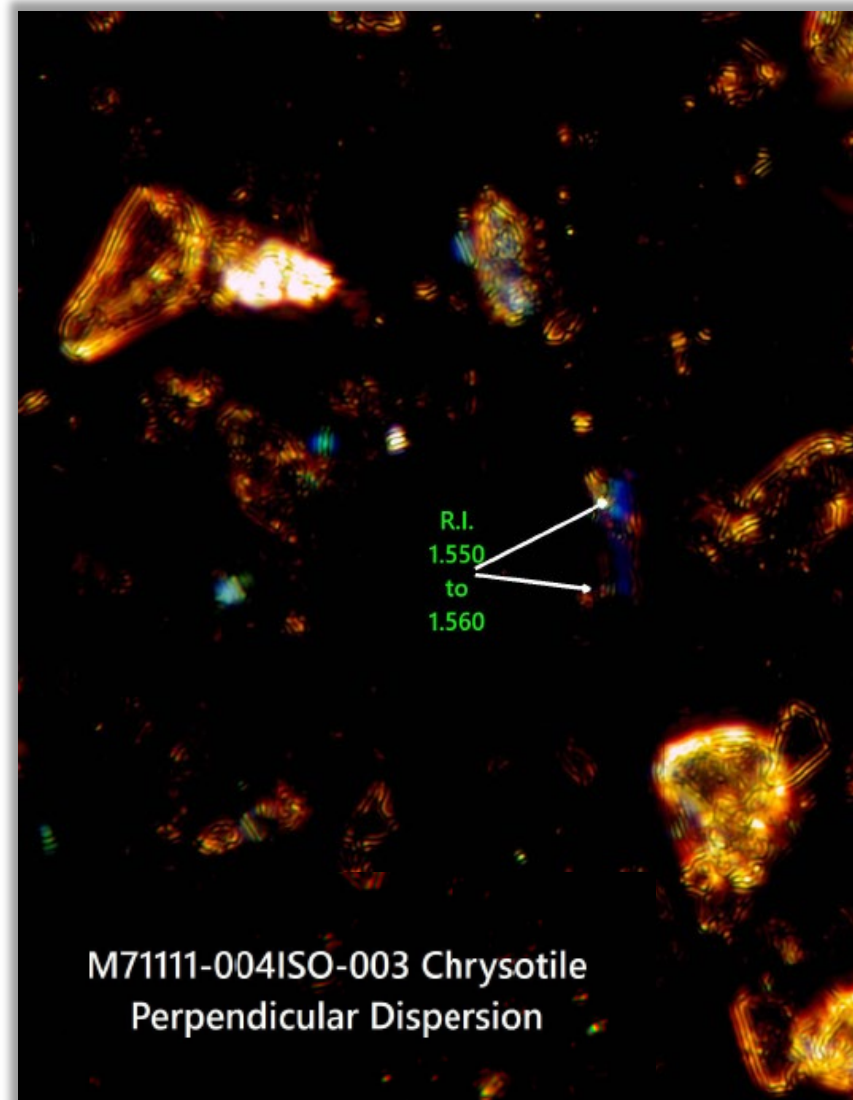
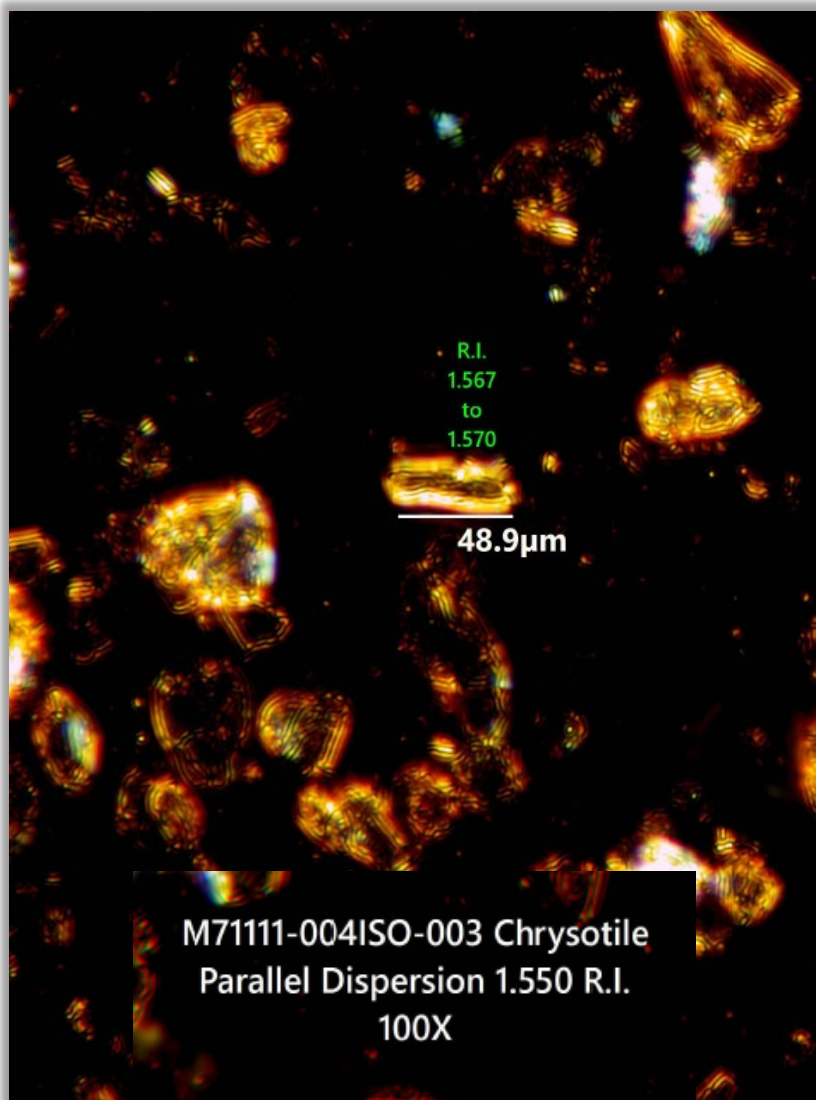


Fig 1. Converting dispersion staining color to corresponding  $\lambda_0$  (McCrone, 1987).

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# Dr. Longo's "Chrysotile": White Balancing





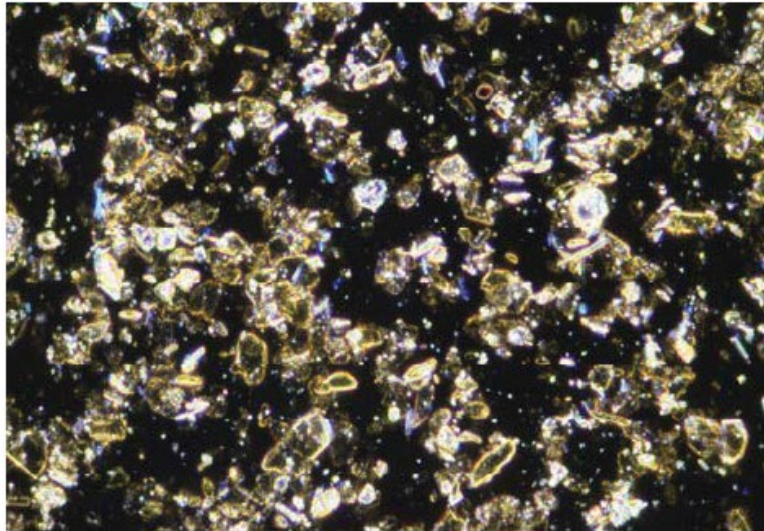
# White Balancing



# Appropriately White Balanced PLM Analyses

## Mr. Poye's PLM (VT talc)

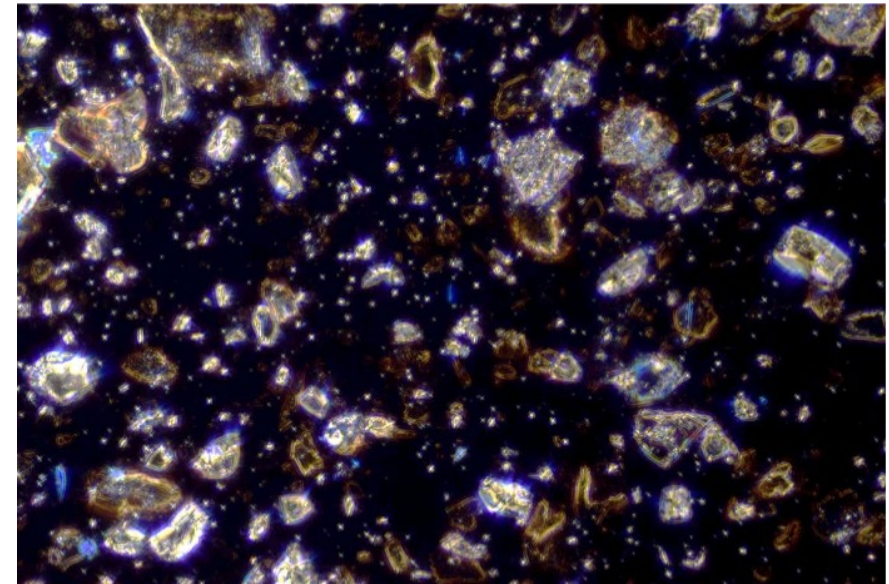
No asbestos was detected by PLM.



*100X Magnification dispersion  
staining of Talc Particles  
1.550 refractive index oil*

## Dr. Sanchez's PLM (VT talc)

No asbestos detected

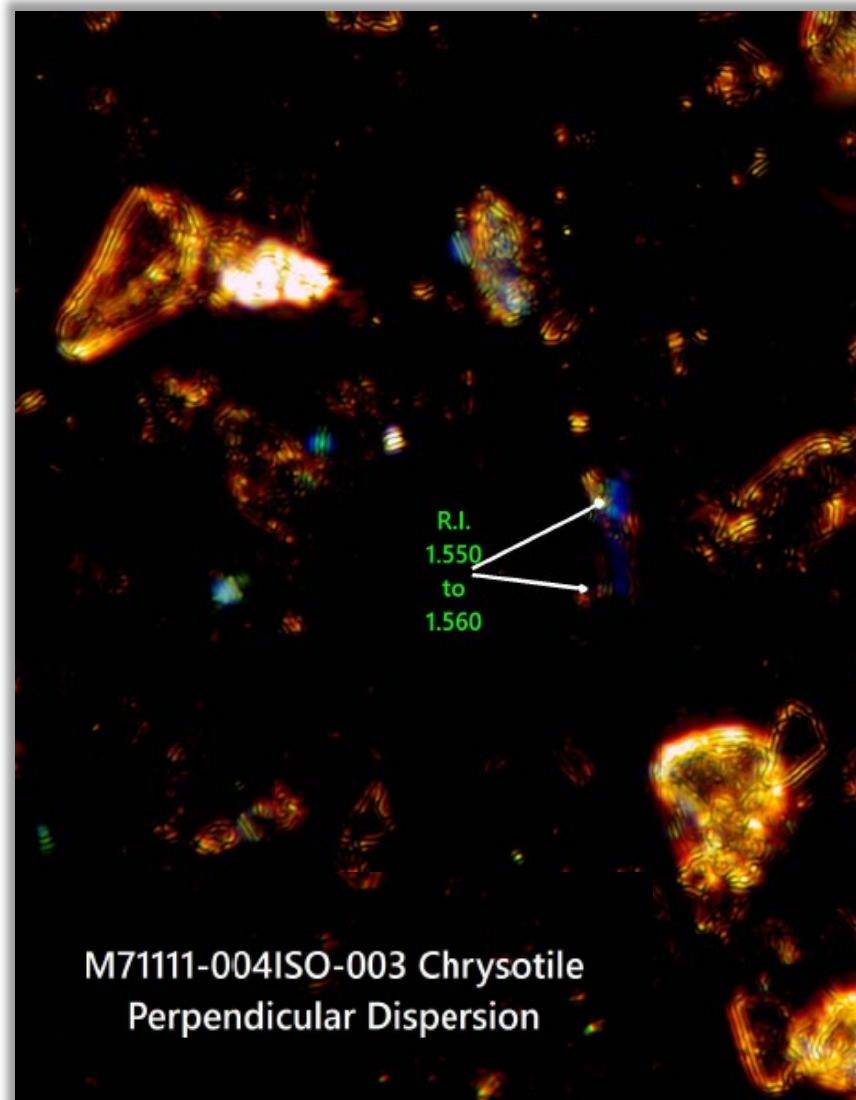
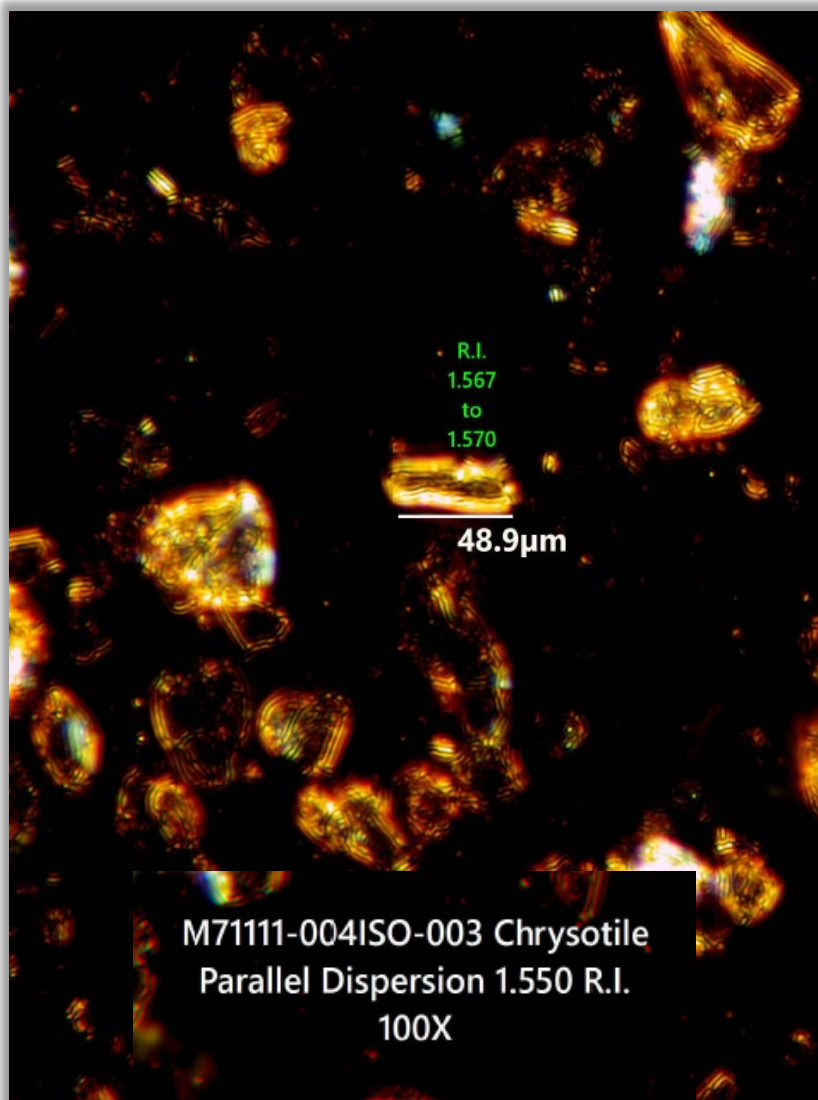


1.550 refractive index oil



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# Dr. Longo's "Chrysotile": White Balancing

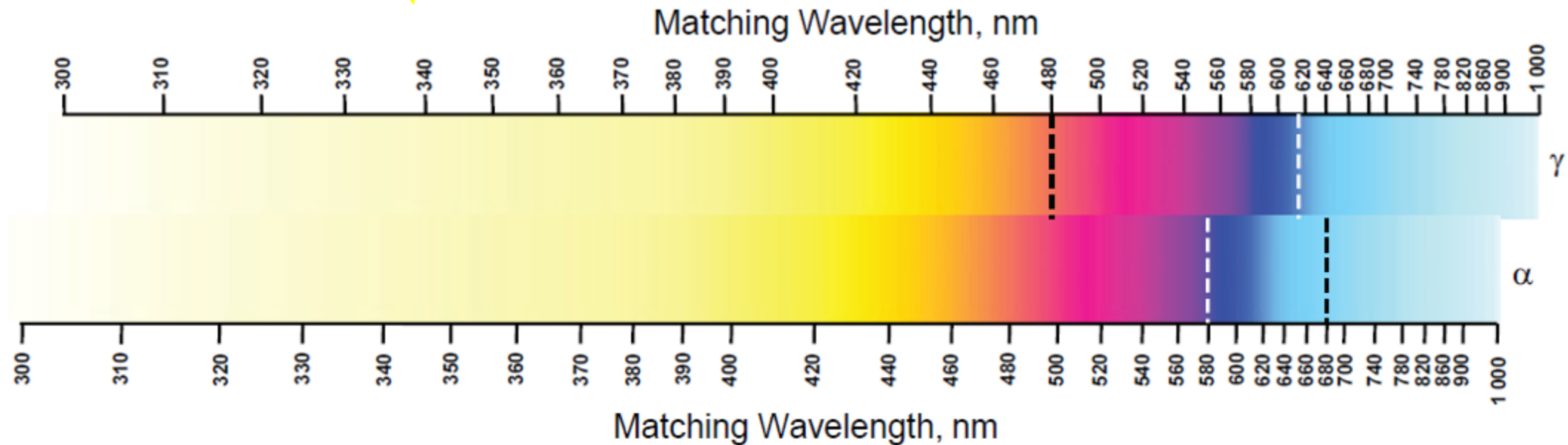




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# How Should Birefringence Be Calculated?

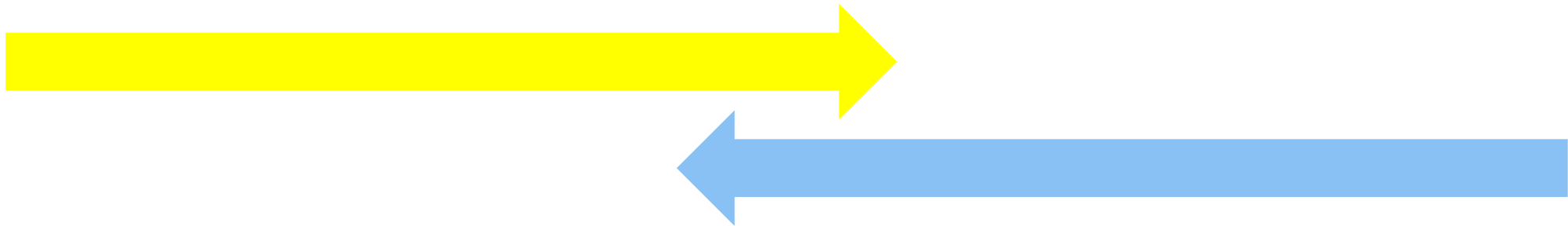
Parallel: **Highest** (Farthest to the **Left**)



Perpendicular: **Lowest** (Farthest to the **Right**)

# Dr. Longo Uses Averages

Moves Refractive Index Values **Closer Together**  
(**More Like Chrysotile**)



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# Averages Not in Published Method

17           Q. Well, but I want to make -- I want to make  
18 crystal clear that there's no question you're using  
19 averages instead of high or low. Right? High and low.

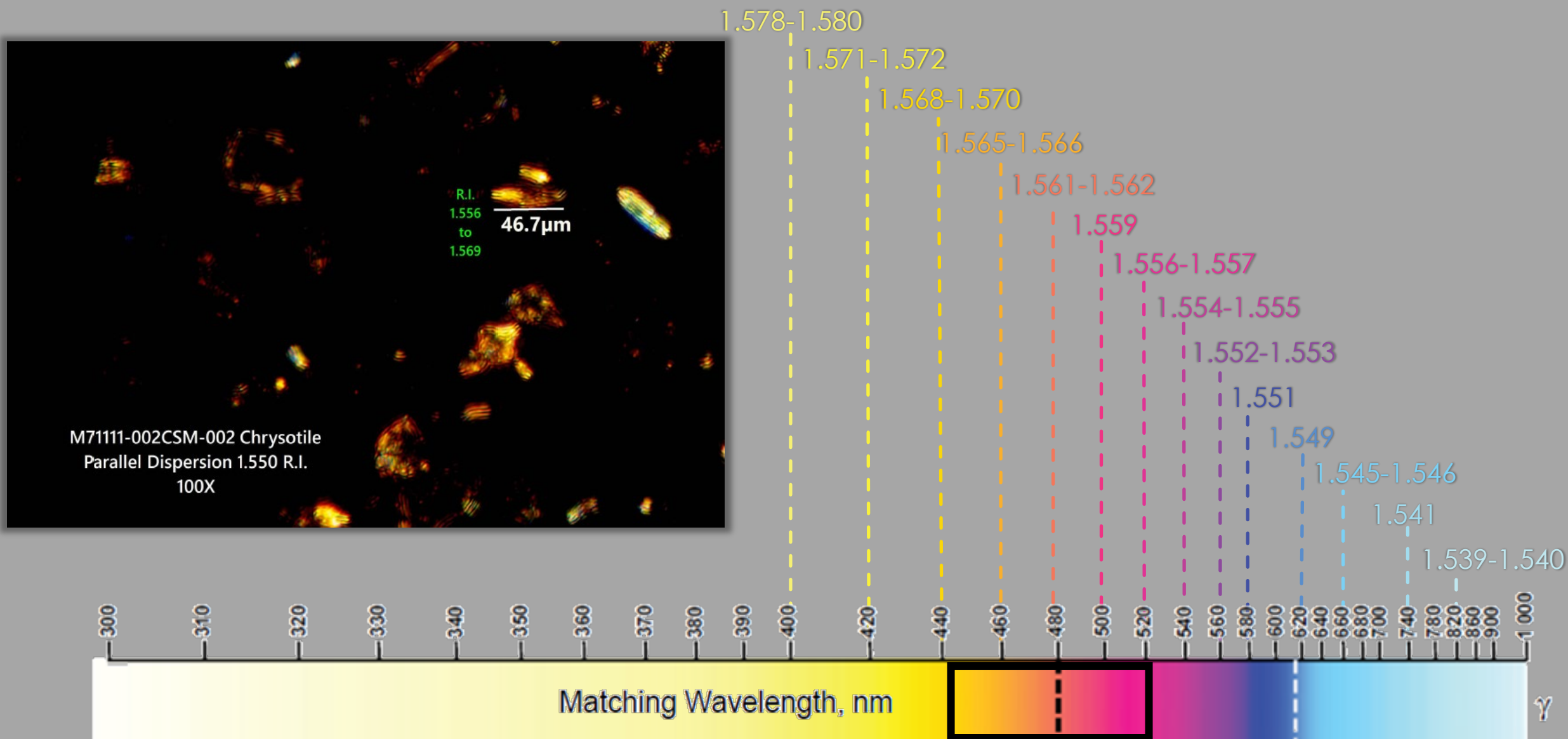
20           A. We do use an average, yes, as I've stated. 09:36:52

21           Q. And in terms of that technique, you don't know  
22 of anywhere where the technique that you're using has  
23 been published or put into a scientific method; right?

24           A. I'm not aware of any, no.

# Dr. Longo's Chrysotile: What Color Is This?

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# Birefringence of Talc vs. Chrysotile

**Chrysotile: Lower** Birefringence (Colors **Closer Together**)

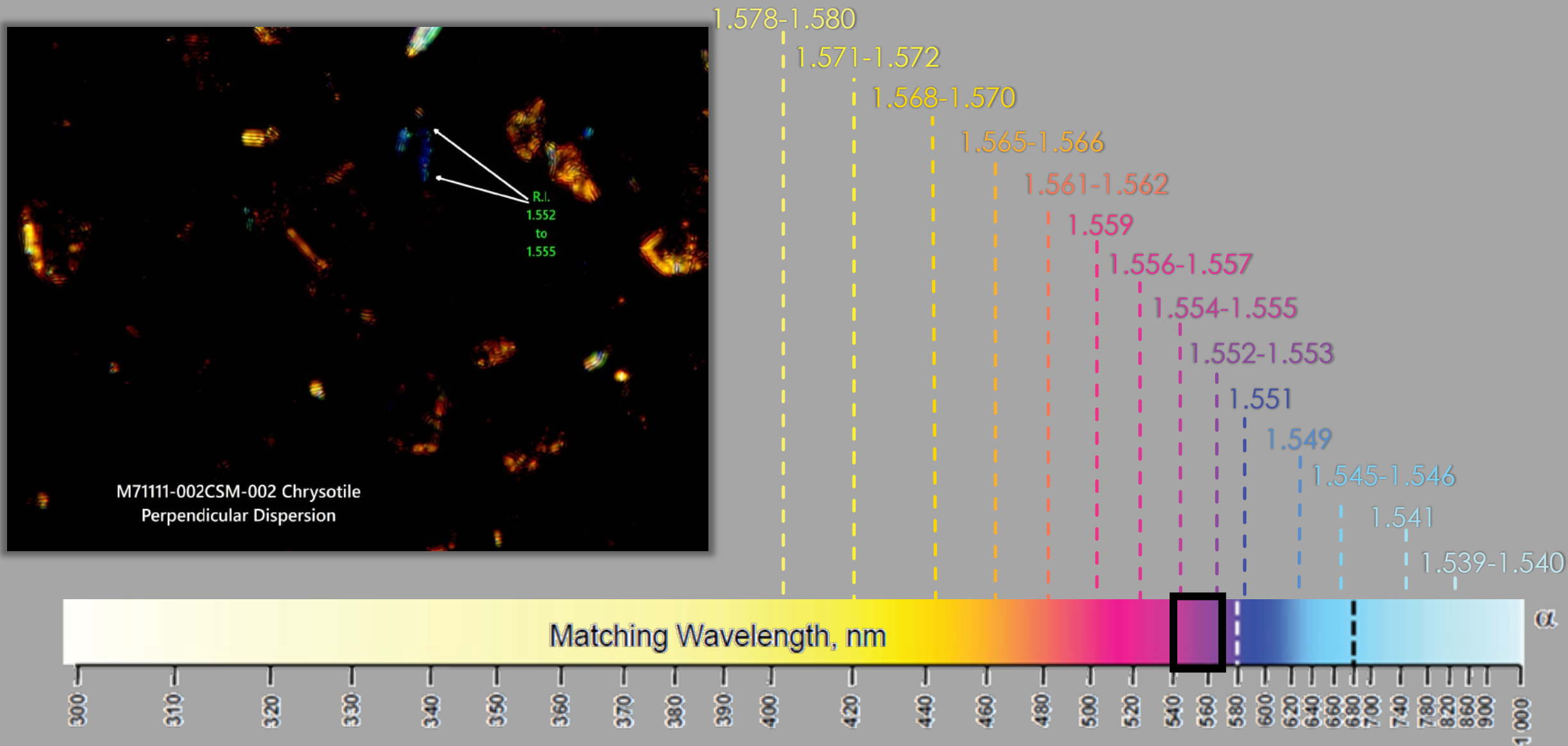


**Talc: Higher** Birefringence (Colors **Farther Apart**)



# Dr. Longo's Chrysotile: What Color Is This?

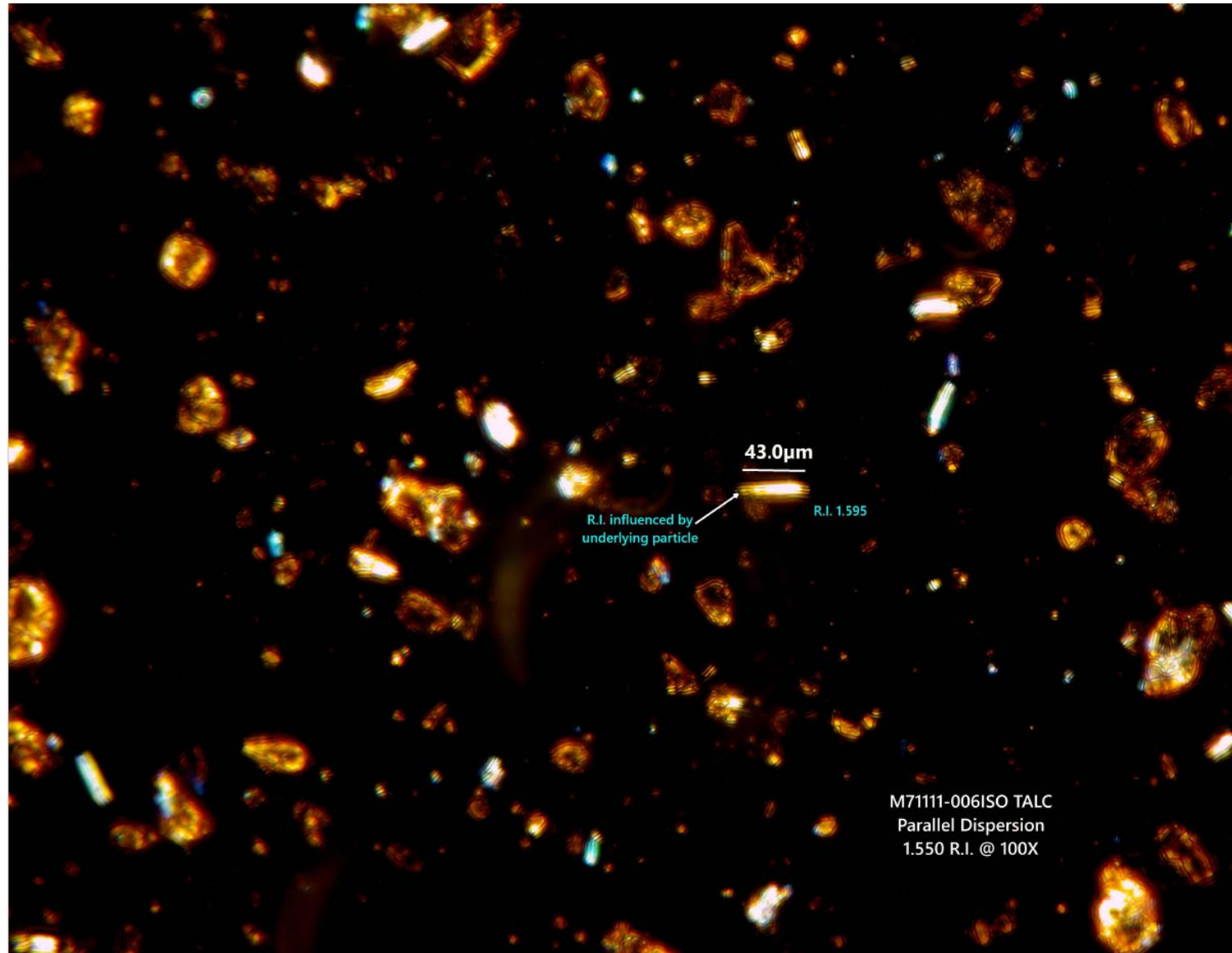
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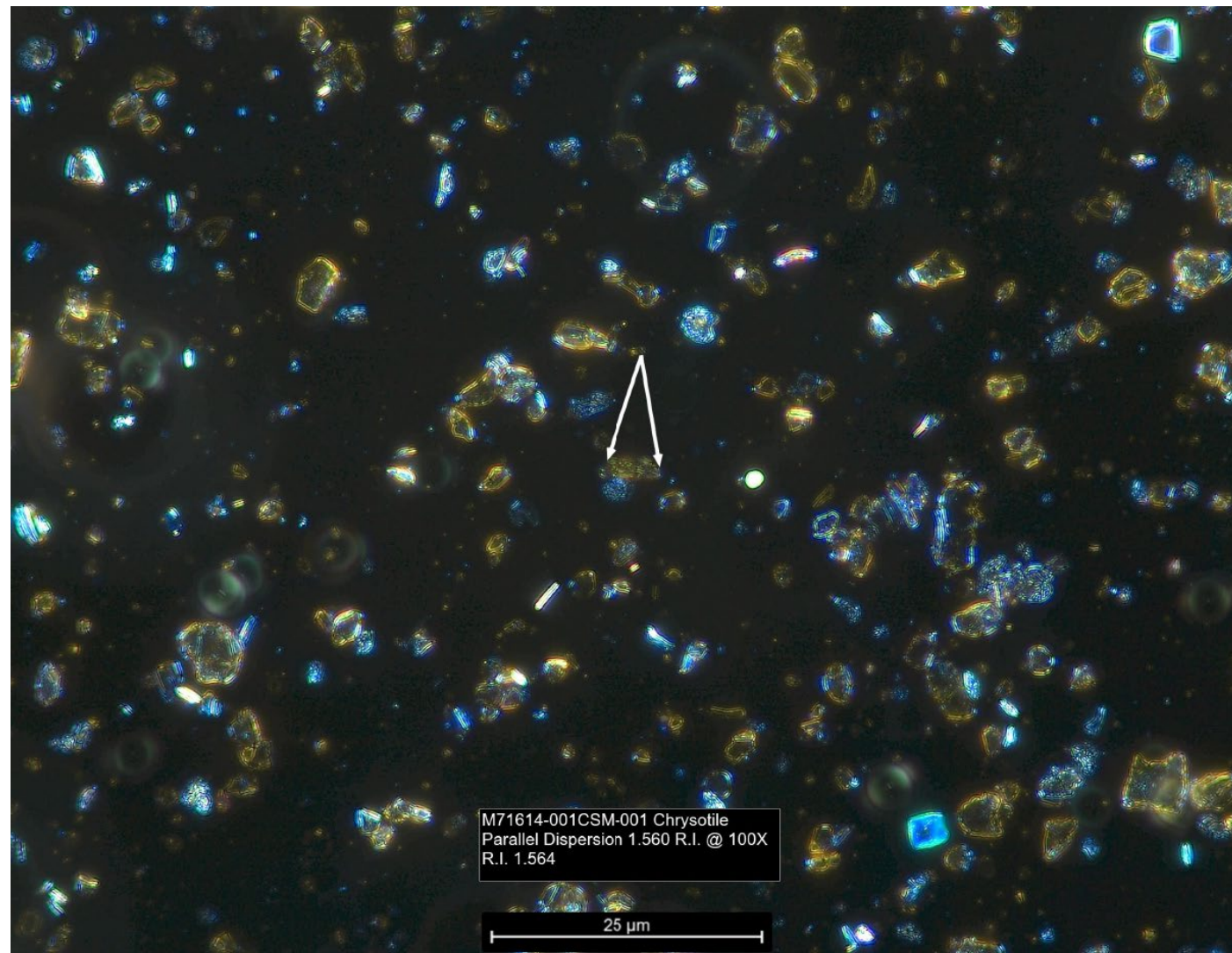
# Su Affidavit

In this case, the rule of thumb is to *bring the yellow CSDS color to purple or magenta or blue range* by using an immersion liquid with a greater RI, such as 1.560 or 1.570 for crystal P at a *normal intensity of illumination* such as B in Fig. 2.

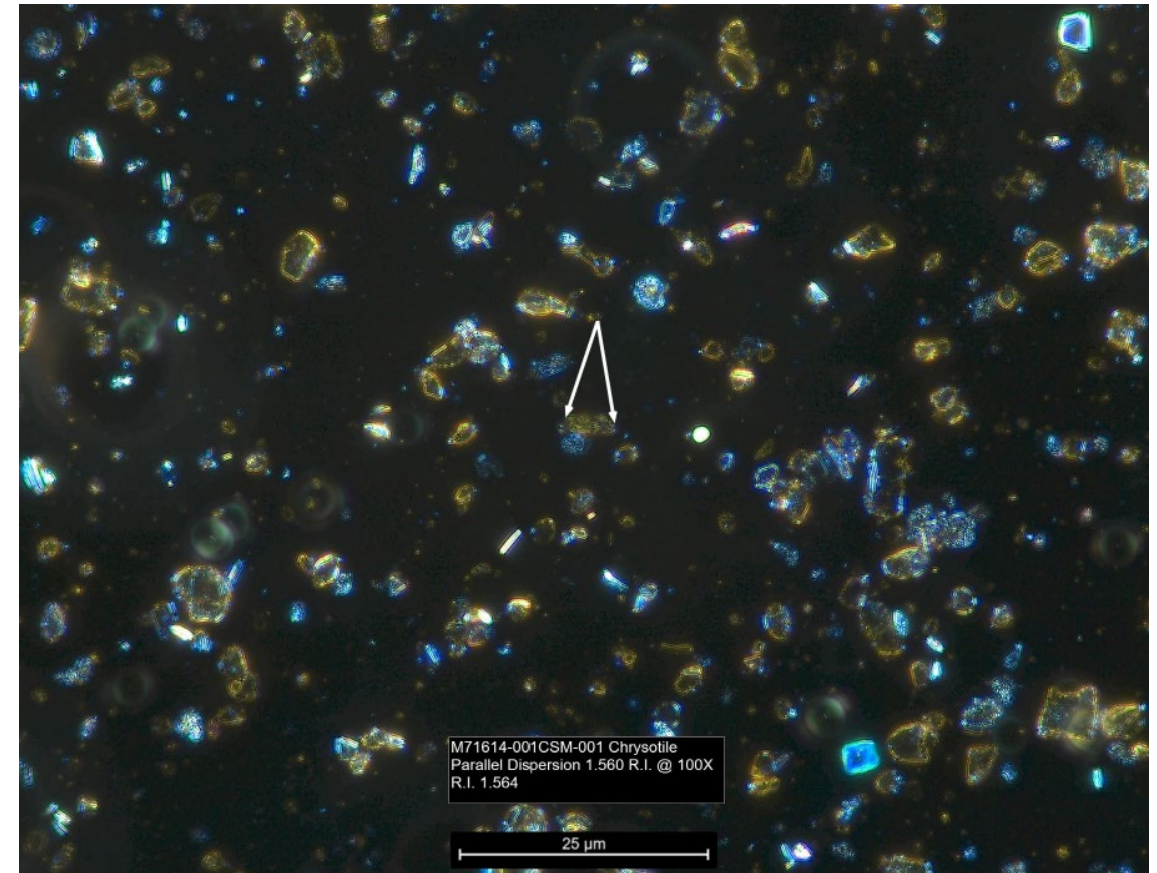
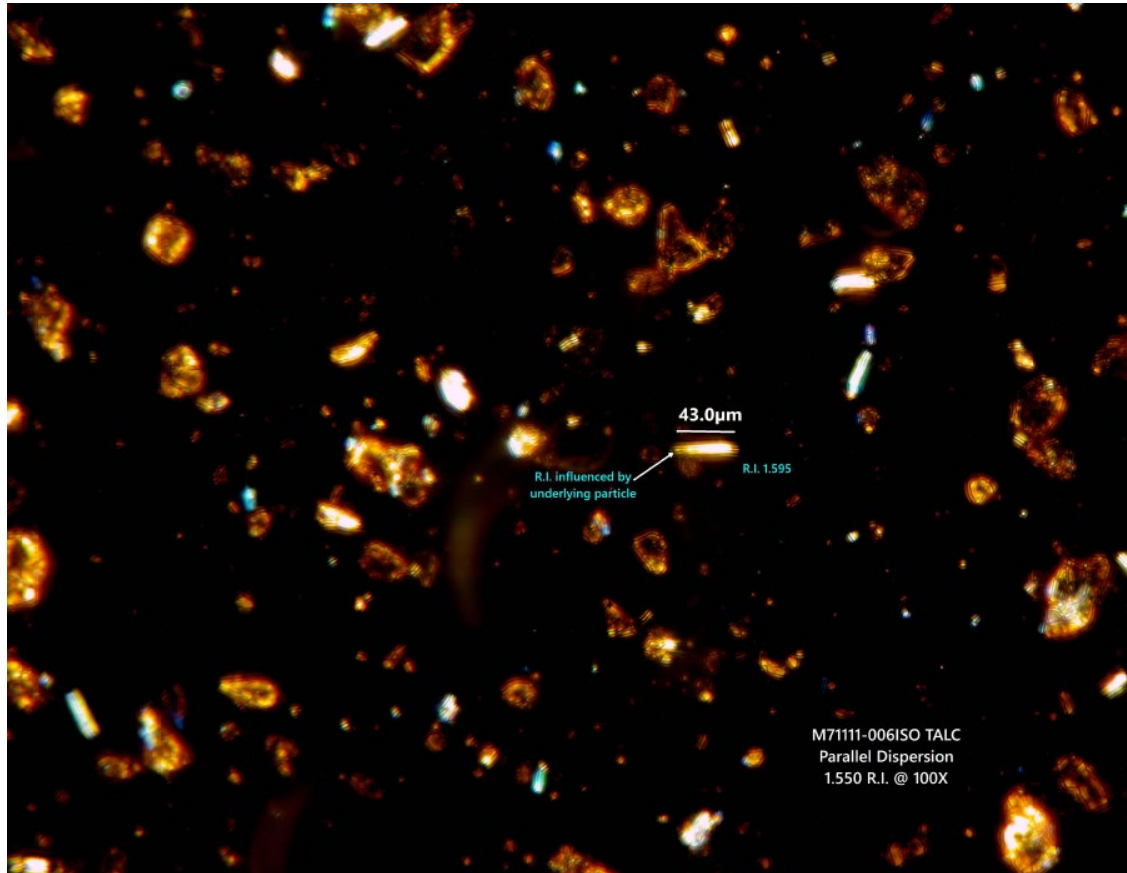
# Sample With 1.550 RI







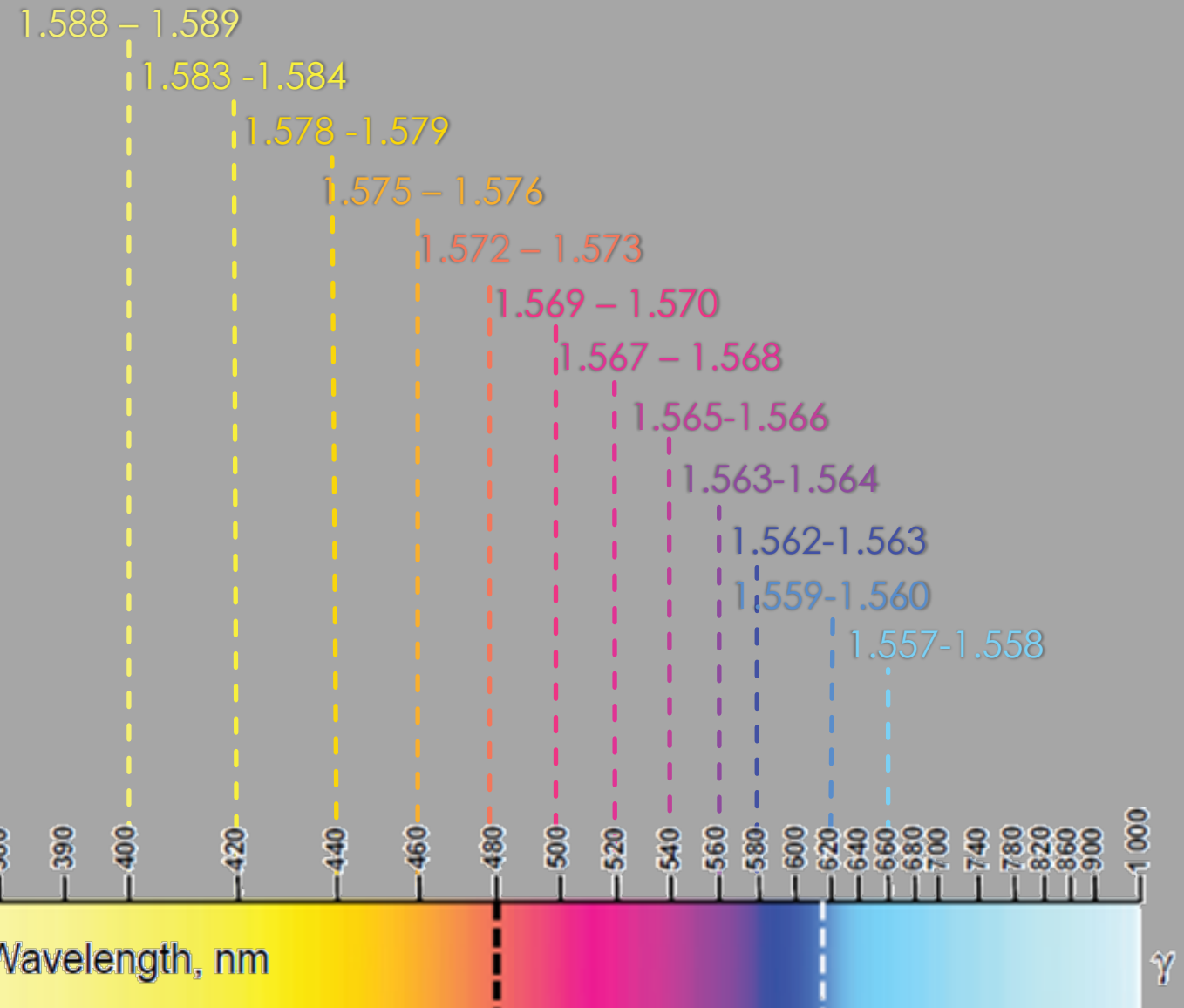
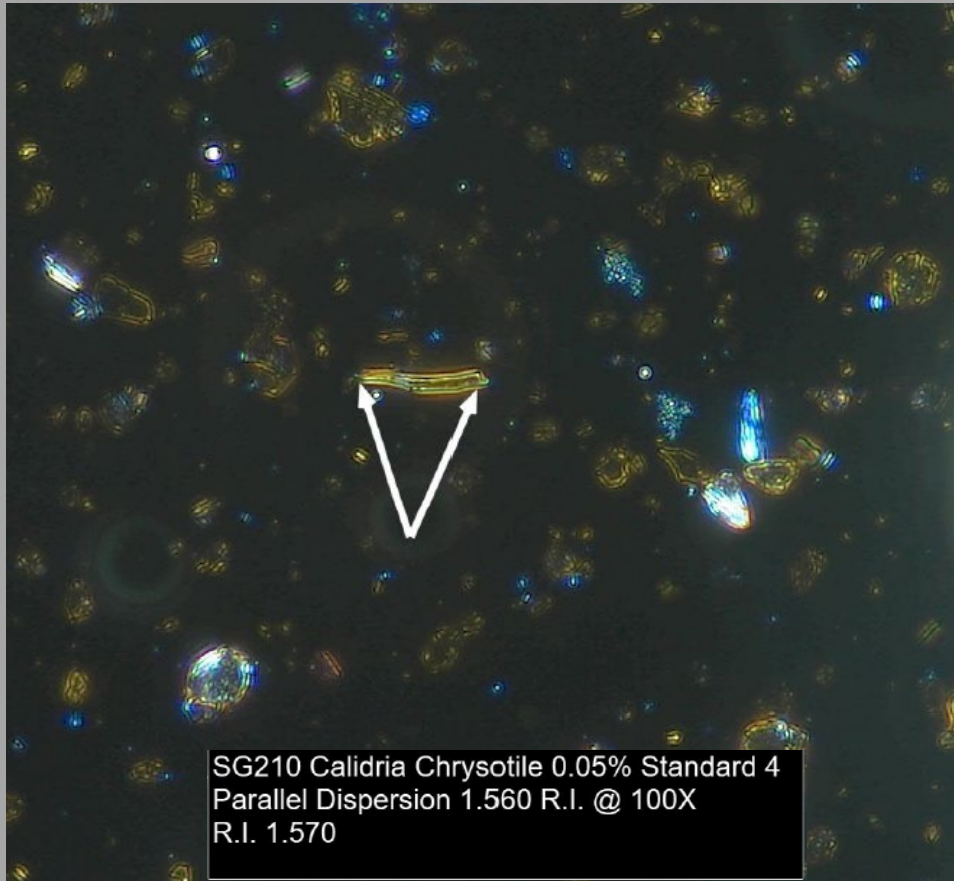
# 1.550 Vs. 1.560 RI





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# Calidria References In 1.560



# Su Refractive Indices

Table 5B. **Chrysotile  $\gamma$**  (In Cargille Series E: **1.560**) )

$\lambda_0$	19°C	21°C	23°C	25°C	27°C	29°C	31°C
400	1.590	1.589	1.588	1.587	1.586	1.585	1.584
420	1.585	1.584	1.583	1.582	1.581	1.580	1.579
440	1.580	1.579	1.578	1.578	1.577	1.576	1.575
460	1.577	1.576	1.575	1.574	1.573	1.572	1.571
480	1.574	1.573	1.572	1.571	1.570	1.569	1.568
500	1.571	1.570	1.569	1.568	1.567	1.566	1.566
520	1.569	1.568	1.567	1.566	1.565	1.564	1.563
540	1.567	1.566	1.565	1.564	1.563	1.562	1.561
560	1.565	1.564	1.563	1.562	1.561	1.560	1.559
580	1.564	1.563	1.562	1.561	1.560	1.559	1.558
589	1.563	1.562	1.561	1.560	1.559	1.558	1.557
600	1.562	1.561	1.560	1.559	1.558	1.557	1.556
620	1.561	1.560	1.559	1.558	1.557	1.556	1.555
640	1.560	1.559	1.558	1.557	1.556	1.555	1.554
660	1.559	1.558	1.557	1.556	1.555	1.554	1.553
680	1.558	1.557	1.556	1.555	1.554	1.553	1.552
700	1.557	1.556	1.555	1.554	1.553	1.552	1.551
750	1.555	1.554	1.553	1.552	1.551	1.550	1.549
800	1.553	1.552	1.551	1.550	1.549	1.548	1.547

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# Birefringence of Talc vs. Chrysotile

**Chrysotile**: **Lower** Birefringence (Colors **Closer Together**)

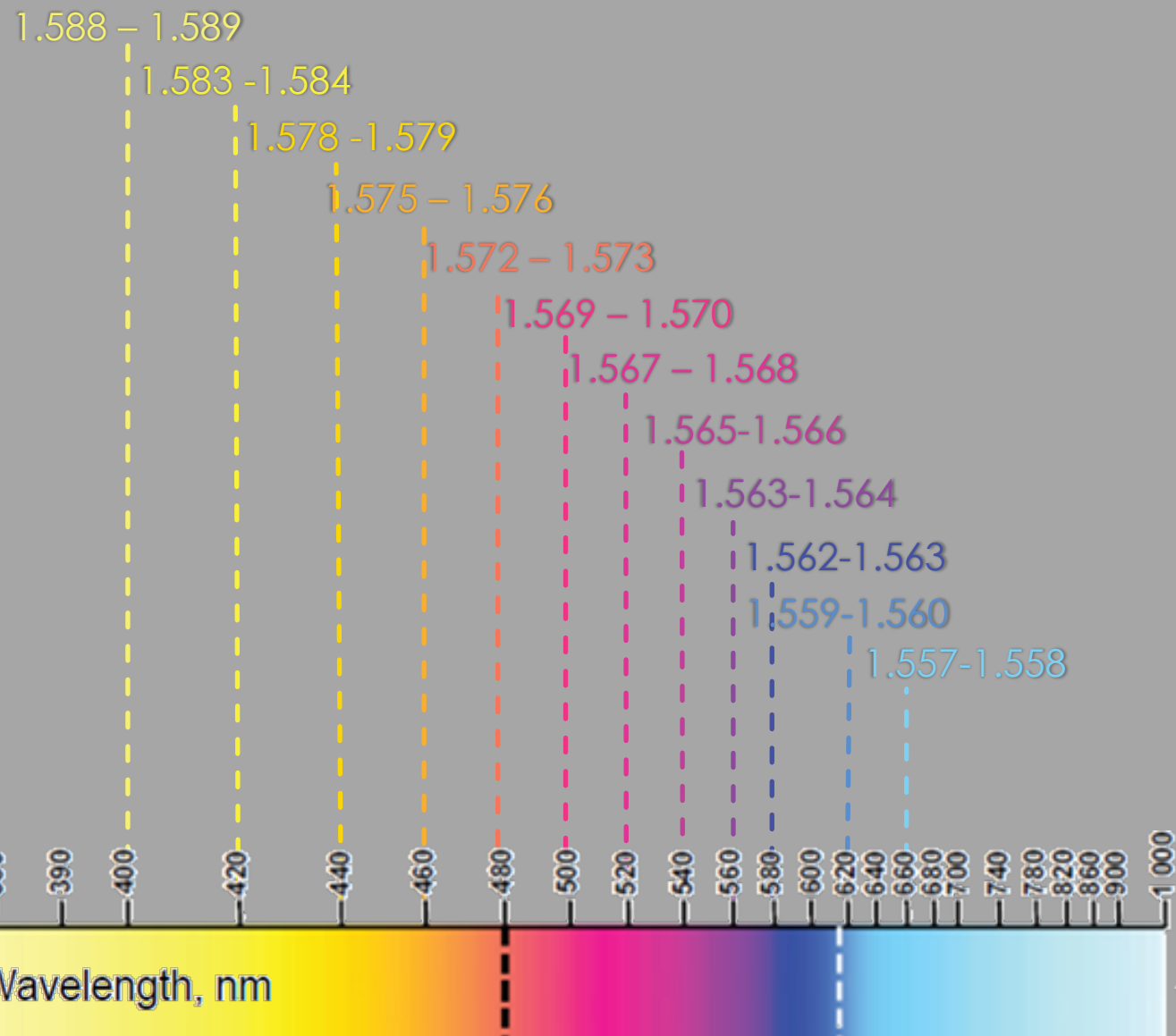
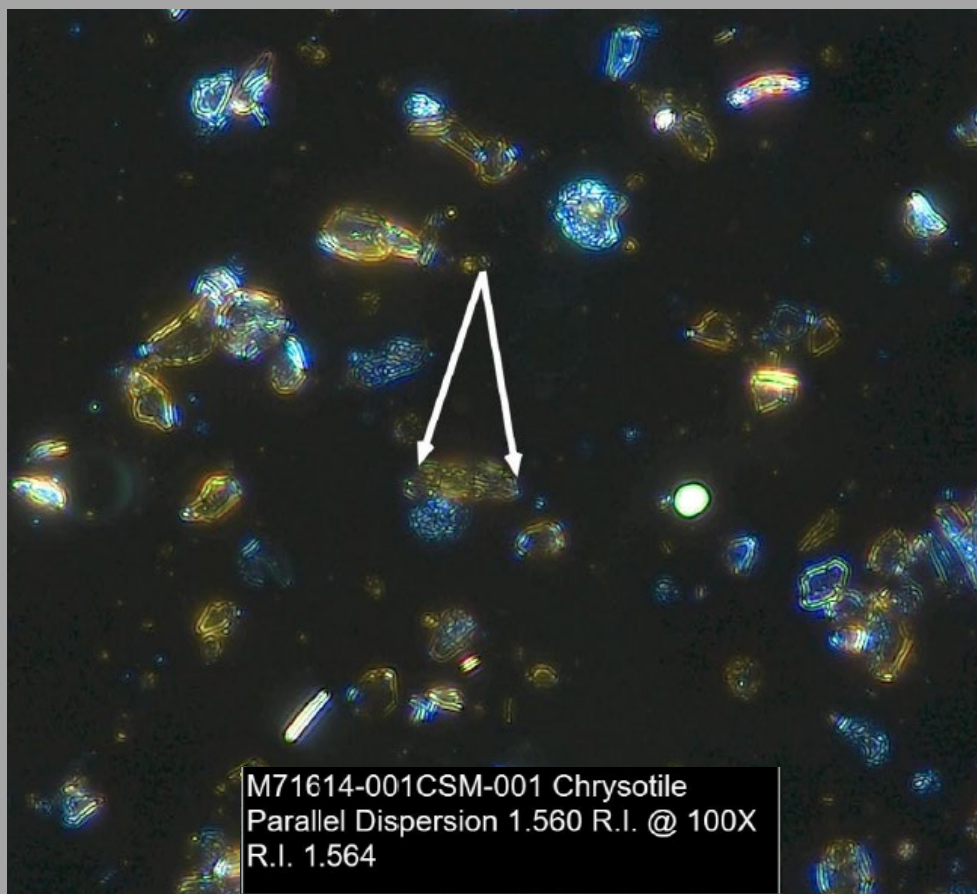


**Talc**: **Higher** Birefringence (Colors **Farther Apart**)



# Dr. Longo's Chrysotile: What Color Is This?

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# Su Refractive Indices

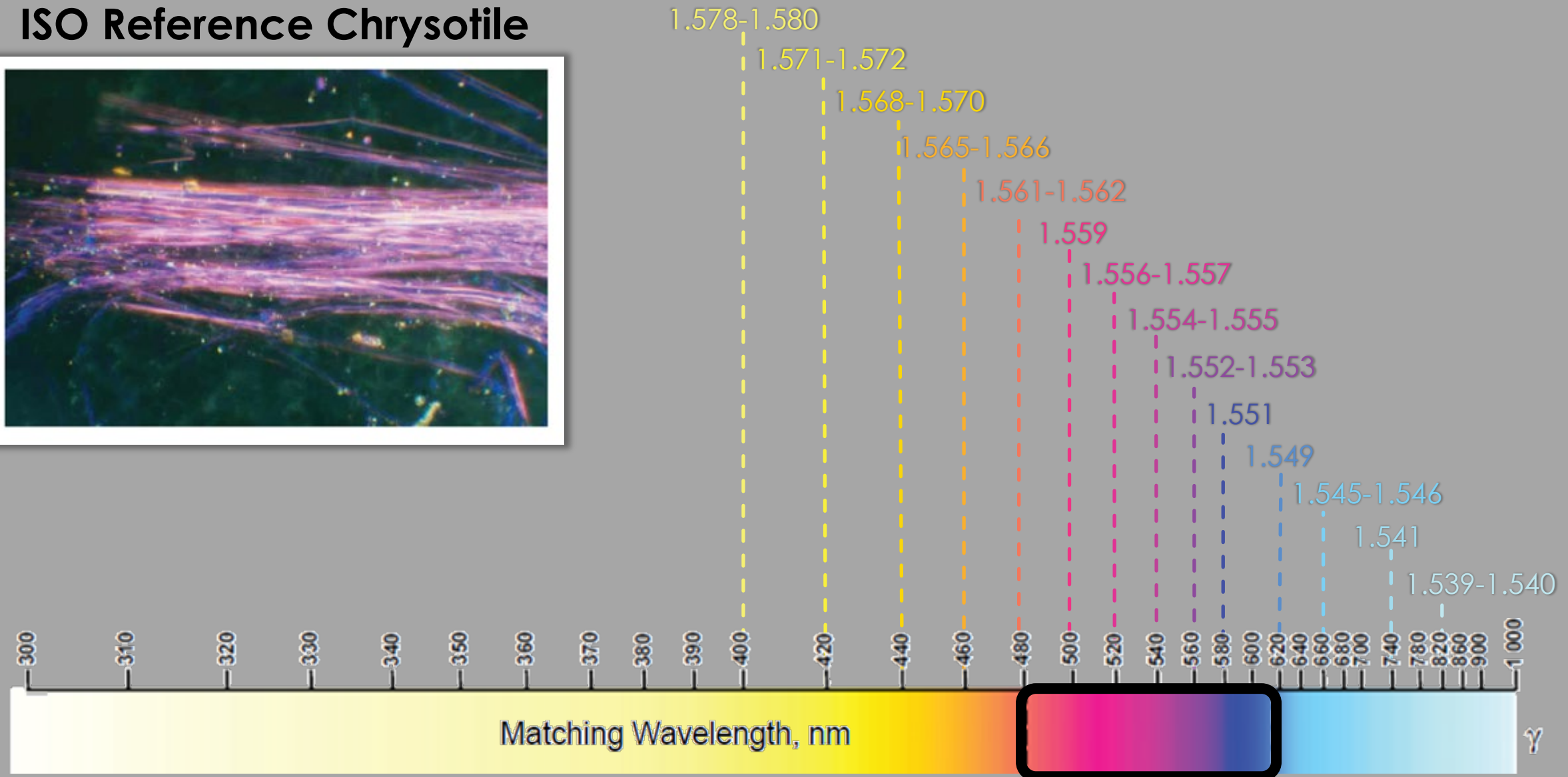
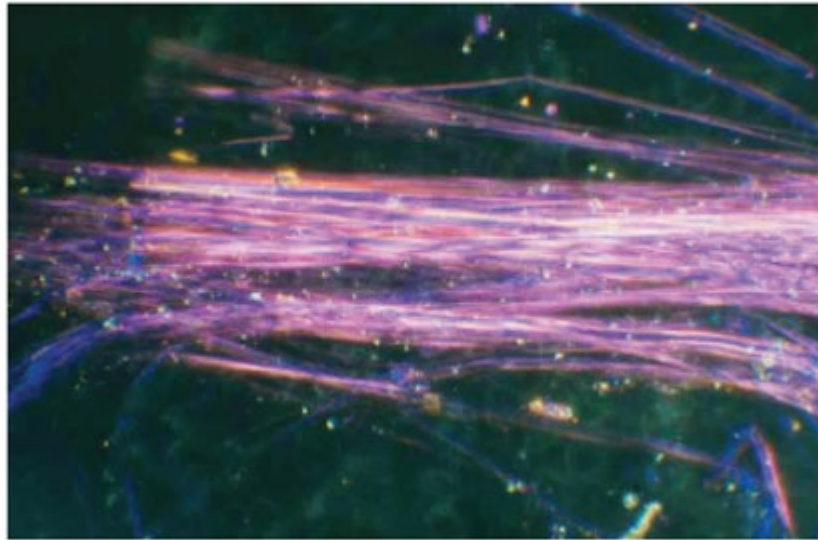
Table 5B. **Chrysotile  $\gamma$**  (In Cargille Series E: 1.560)  $\gamma$

$\lambda_0$	19°C	21°C	23°C	25°C	27°C	29°C	31°C
400	1.590	1.589	1.588	1.587	1.586	1.585	1.584
420	1.585	1.584	1.583	1.582	1.581	1.580	1.579
440	1.580	1.579	1.578	1.578	1.577	1.576	1.575
460	1.577	1.576	1.575	1.574	1.573	1.572	1.571
480	1.574	1.573	1.572	1.571	1.570	1.569	1.568
500	1.571	1.570	1.569	1.568	1.567	1.566	1.566
520	1.569	1.568	1.567	1.566	1.565	1.564	1.563
540	1.567	1.566	1.565	1.564	1.563	1.562	1.561
560	1.565	1.564	1.563	1.562	1.561	1.560	1.559
580	1.564	1.563	1.562	1.561	1.560	1.559	1.558
589	1.563	1.562	1.561	1.560	1.559	1.558	1.557
600	1.562	1.561	1.560	1.559	1.558	1.557	1.556
620	1.561	1.560	1.559	1.558	1.557	1.556	1.555
640	1.560	1.559	1.558	1.557	1.556	1.555	1.554
660	1.559	1.558	1.557	1.556	1.555	1.554	1.553
680	1.558	1.557	1.556	1.555	1.554	1.553	1.552
700	1.557	1.556	1.555	1.554	1.553	1.552	1.551
750	1.555	1.554	1.553	1.552	1.551	1.550	1.549
800	1.553	1.552	1.551	1.550	1.549	1.548	1.547



# ISO Reference Chrysotile: Parallel

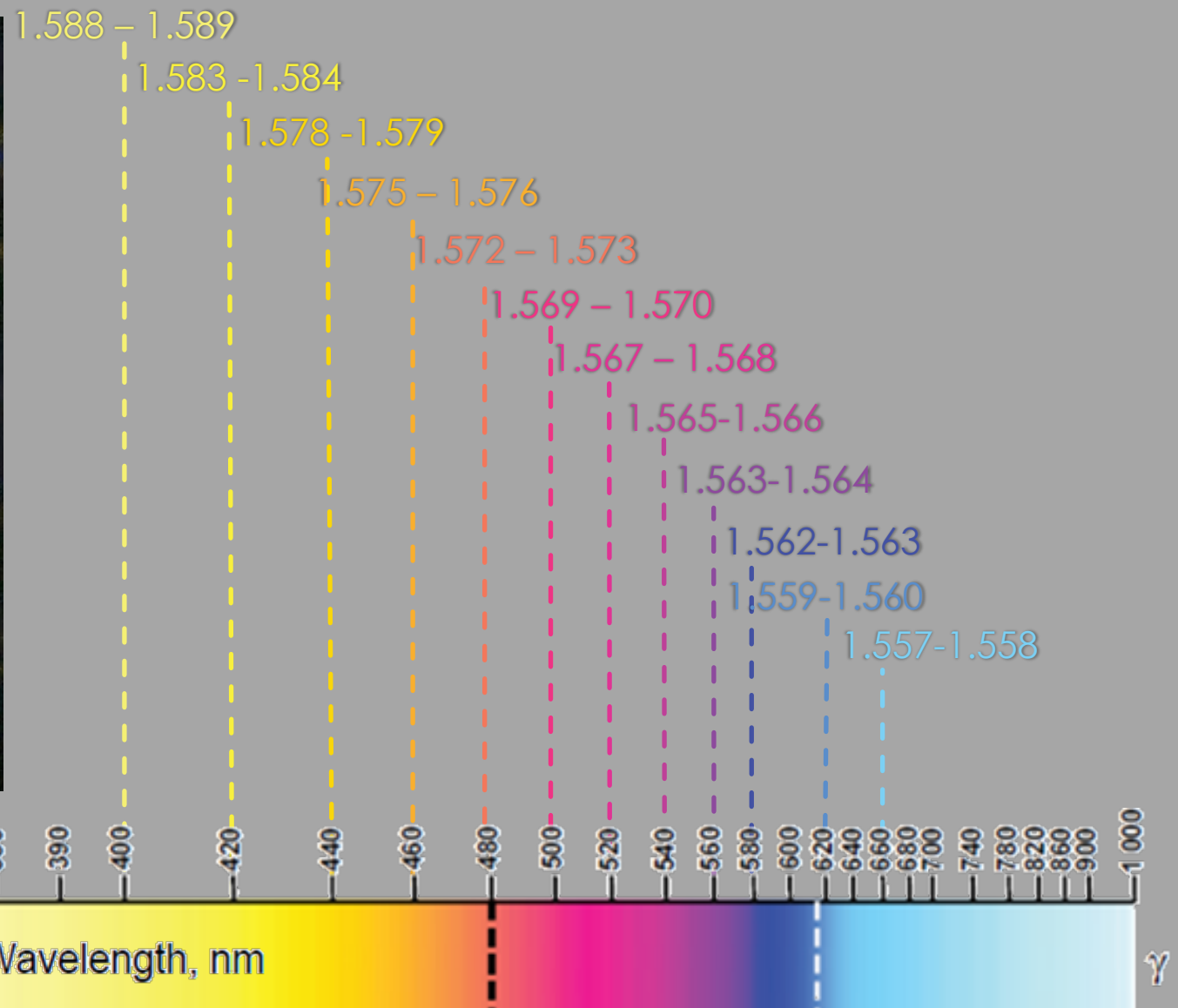
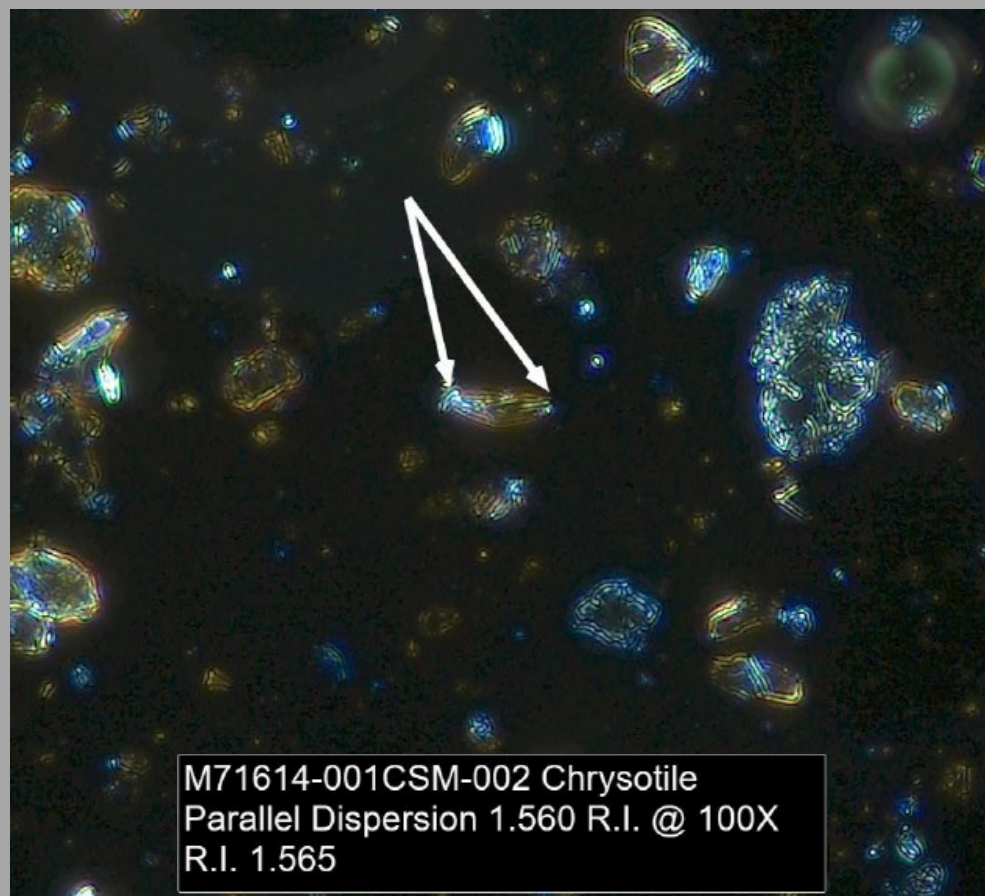
## ISO Reference Chrysotile





# Dr. Longo's Chrysotile: What Color Is This?

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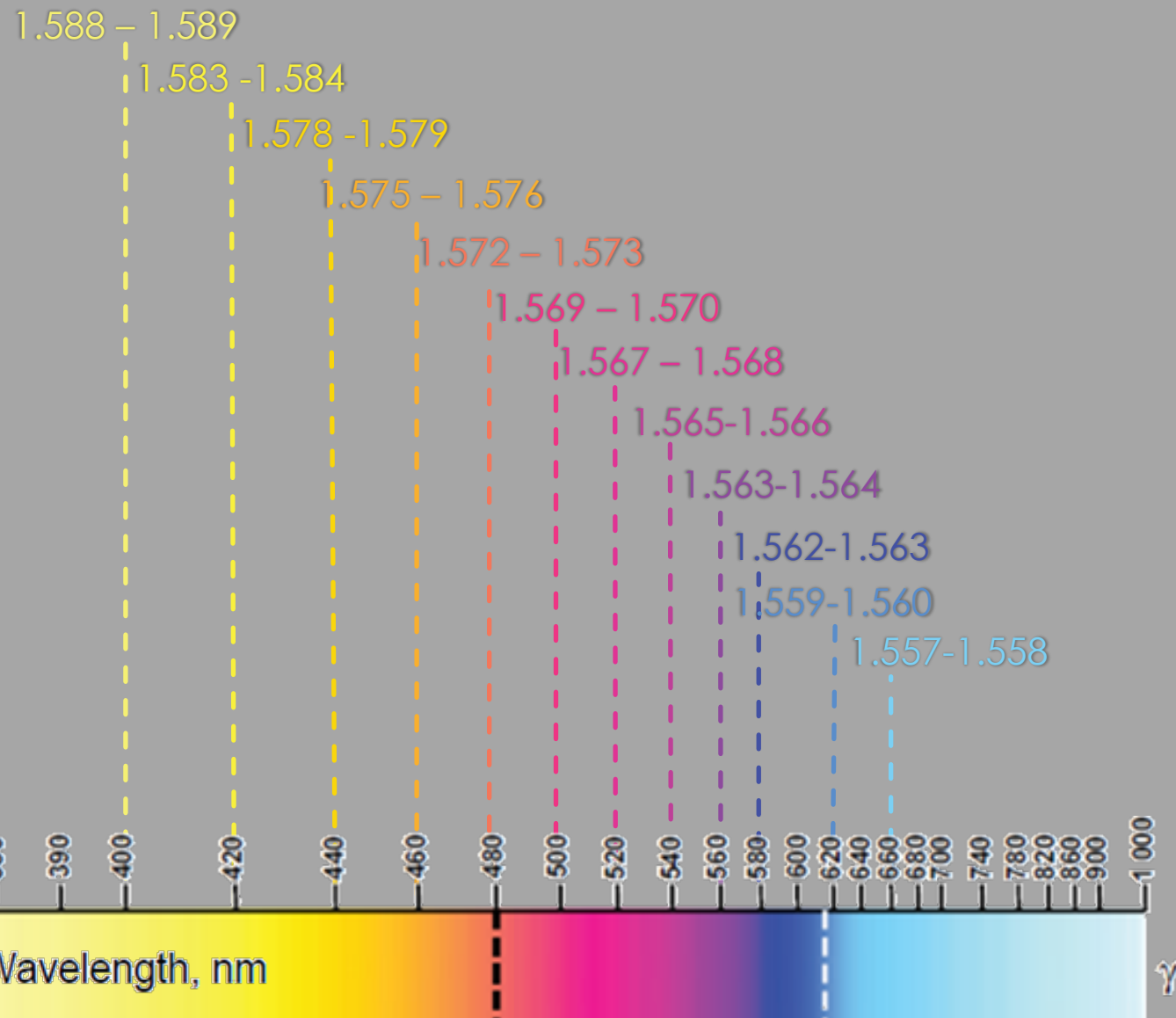
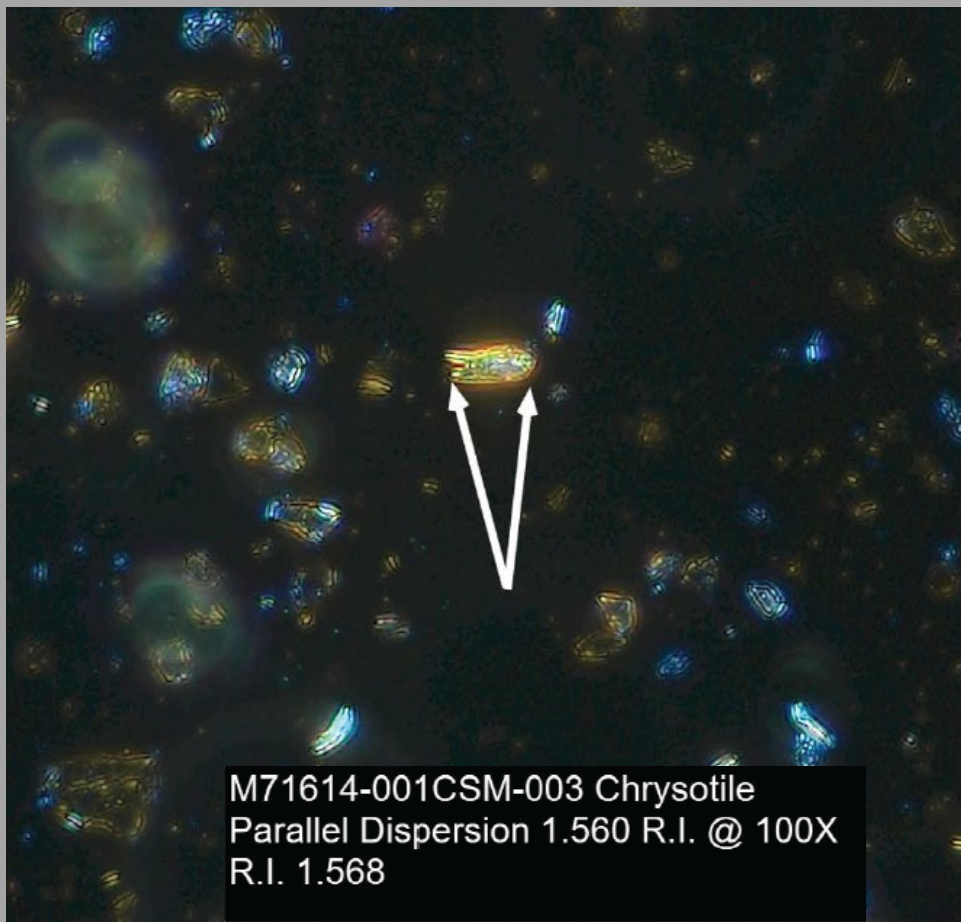
# Su Refractive Indices

Table 5B. **Chrysotile  $\gamma$**  (In Cargille Series E: 1.560)  $\gamma$

$\lambda_0$	19°C	21°C	23°C	25°C	27°C	29°C	31°C
400	1.590	1.589	1.588	1.587	1.586	1.585	1.584
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440	1.580	1.579	1.578	1.578	1.577	1.576	1.575
460	1.577	1.576	1.575	1.574	1.573	1.572	1.571
480	1.574	1.573	1.572	1.571	1.570	1.569	1.568
500	1.571	1.570	1.569	1.568	1.567	1.566	1.566
520	1.569	1.568	1.567	1.566	1.565	1.564	1.563
540	1.567	1.566	1.565	1.564	1.563	1.562	1.561
560	1.565	1.564	1.563	1.562	1.561	1.560	1.559
580	1.564	1.563	1.562	1.561	1.560	1.559	1.558
589	1.563	1.562	1.561	1.560	1.559	1.558	1.557
600	1.562	1.561	1.560	1.559	1.558	1.557	1.556
620	1.561	1.560	1.559	1.558	1.557	1.556	1.555
640	1.560	1.559	1.558	1.557	1.556	1.555	1.554
660	1.559	1.558	1.557	1.556	1.555	1.554	1.553
680	1.558	1.557	1.556	1.555	1.554	1.553	1.552
700	1.557	1.556	1.555	1.554	1.553	1.552	1.551
750	1.555	1.554	1.553	1.552	1.551	1.550	1.549
800	1.553	1.552	1.551	1.550	1.549	1.548	1.547

# Dr. Longo's Chrysotile: What Color Is This?

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# Su Refractive Indices

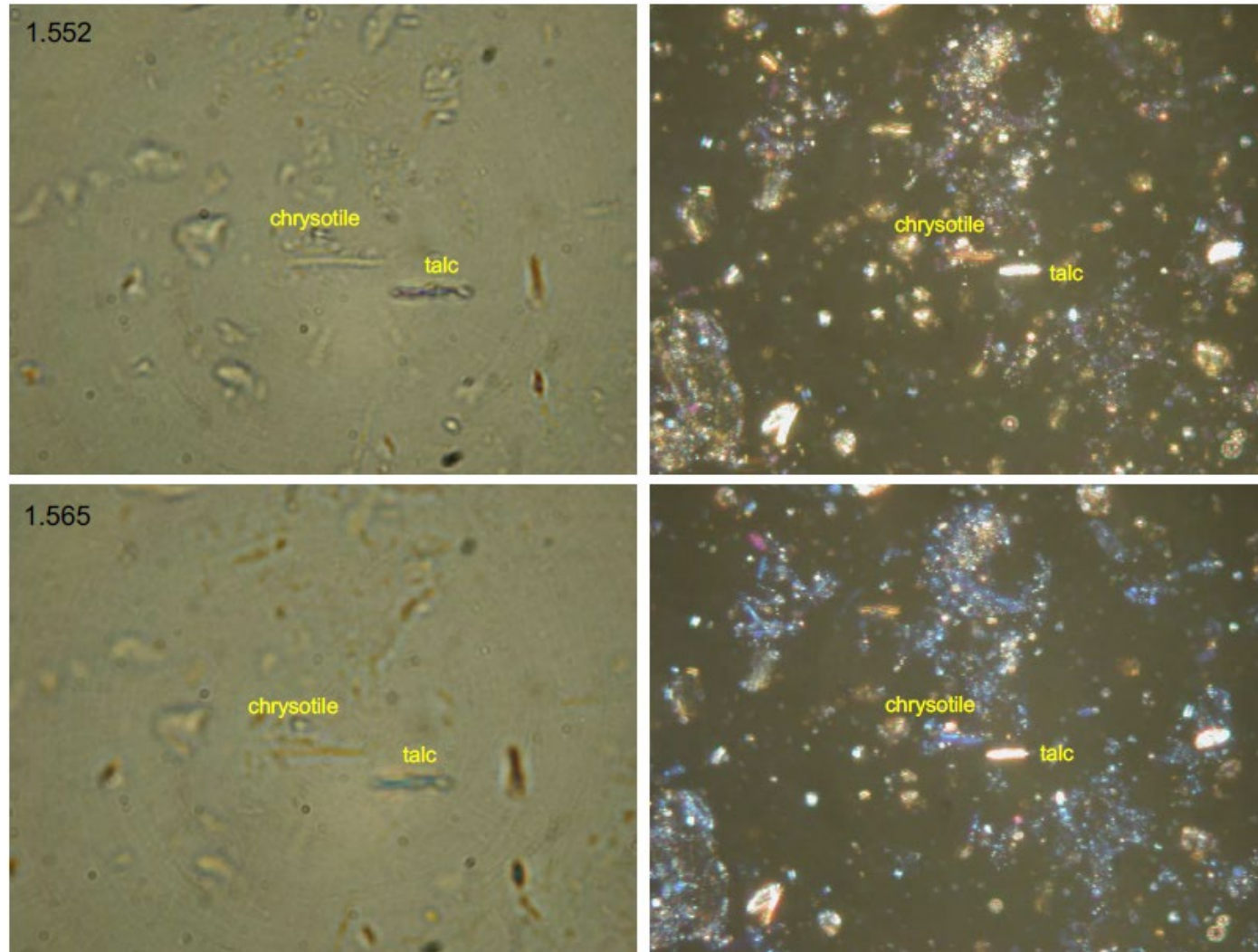
Table 5B. **Chrysotile  $\gamma$**  (In Cargille Series E: 1.560)  $\lambda_0$

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480	1.574	1.573	1.572	1.571	1.570	1.569	1.568
500	1.571	1.570	1.569	1.568	1.567	1.566	1.566
520	1.569	1.568	1.567	1.566	1.565	1.564	1.563
540	1.567	1.566	1.565	1.564	1.563	1.562	1.561
560	1.565	1.564	1.563	1.562	1.561	1.560	1.559
580	1.564	1.563	1.562	1.561	1.560	1.559	1.558
589	1.563	1.562	1.561	1.560	1.559	1.558	1.557
600	1.562	1.561	1.560	1.559	1.558	1.557	1.556
620	1.561	1.560	1.559	1.558	1.557	1.556	1.555
640	1.560	1.559	1.558	1.557	1.556	1.555	1.554
660	1.559	1.558	1.557	1.556	1.555	1.554	1.553
680	1.558	1.557	1.556	1.555	1.554	1.553	1.552
700	1.557	1.556	1.555	1.554	1.553	1.552	1.551
750	1.555	1.554	1.553	1.552	1.551	1.550	1.549
800	1.553	1.552	1.551	1.550	1.549	1.548	1.547



# Gunter Images

Figure 19: PLM images of a 50/50 mixture of Calidria 210 and Gold Bond #3 (upper row in 1.552 liquid, lower row in 1.565 liquid).





# Longo: 1.550 RI vs 1.560 RI

